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REMOTE-CONTROLLED PROTECTION SYSTEM FOR A MOTOR VEHICLE

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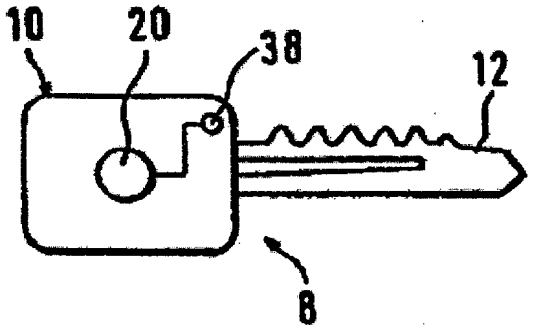
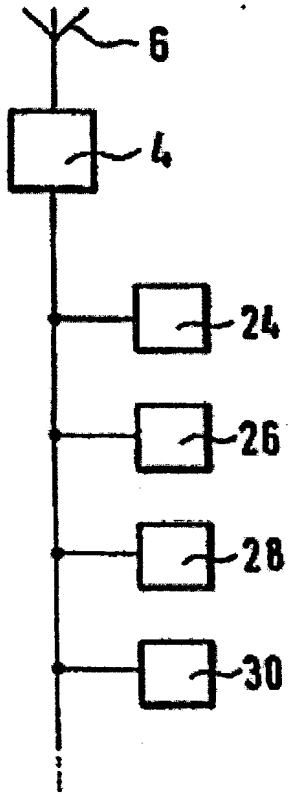
Abstract

System for contactless protection of a vehicle. Said system consists of a remote-control key (8) for generating and transmitting an unlocking signal (F, R) as well as a system arranged in the vehicle (4, 6) for receiving and processing the unlocking signal. According to the invention, the unlocking signal (F, R) is changed each time the remote control key (6) is actuated.





The invention starts from a device in accordance with the class of the main claim.

In order to secure motor vehicles against unauthorized usage, the use of securing devices is known that only allow the vehicle to be started if a code signal produced by a startup device agrees with a reference code signal present in the vehicle. Known devices generally comprise the locking devices of vehicle doors as well as control devices for controlling the operation of vehicle components essential for operation such as the starter, gas pump or the injection system

of the central engine control device. A starting of a vehicle secured in this manner is not even possible if a non-authorized person has gained access to the vehicle cab and has short-circuited the ignition. The security device is typically actuated with the aid of a remote control that generates, e.g., coded high-frequency or infrared signals.

A weak point of these known devices is the fact that they can be circumvented by an unauthorized recording of the code signal transmitted between the vehicle key and the vehicle. Once recorded, the control signals can be reproduced in any manner, thus allowing an unauthorized user to operate the vehicle.

The invention has the problem of indicating a remote control security device that avoids an unauthorized starting of a vehicle by a simple recording and reproduction of an unlocking signal.

This problem is solved by a device with the characterizing features of the main claim. In a security device in accordance with the invention the unlocking code transmitted between the remote control key and the vehicle is changed for each actuation of the security device. The change takes place in the remote control key and, in the same manner, in the receiving device arranged in the vehicle. The advantage of the continual changing of the unlocking code is that an unlocking of the vehicle with the aid of a code recorded during a previous unlocking action is not possible. A recorded code would be identical to the one used during the last previous unlocking action but the receiving device arranged in the vehicle would always expect a code that had been changed from the previous one. It would therefore not react to a repeated use of the same code.

Advantageous further developments and advantageous embodiments of the security device of the invention result from the dependent claims.

It proved to be advantageous regarding the simple realization achieved in this manner to generate the actual unlocking code by linking an unchangeable fixed code and a rolling code that changes upon each actuation. The linking takes place in a logical linking unit in accordance with a given logical rule.

In order to make it possible for an authorized user to operate the vehicle even when the remote control was inadvertently actuated without an unlocking of the vehicle having taken place, it is advantageous to design the evaluation unit that receives the unlocking code in such a manner that that it allows an unlocking even if the received code differs from the expected one by a given number of actuations. The number of actuation events by which the unlocking code emitted by the remote control and the unlocking code expected by the evaluation unit may differ is advantageously in the range of 100 to 500, preferably 250.

An exemplary embodiment of the invention is described in detail in the following with reference made to the drawings.

Drawings

Figure 1 shows a basic circuit diagram of the suggested security device. Figure 2 shows a block diagram of a transmitting and receiving device. Figure 3 shows a flowchart of the code testing process.

Basic elements of the suggested security device are, as shown in Figure 1, remote control 8 in the form of a remote-control key as well as evaluation unit 4 arranged in the vehicle to be secured, which unit receives signals emitted from remote-control key 8 via antenna 6. Key 8 is composed of grip housing 10 and key blade 12 projecting from it. However, the latter can also be missing or realized in a separate key. Signal generating device 14 for generating an unlocking signal and antenna 38 for transmitting the generated signals are located in grip housing 10, designated in the following simply as the housing. Furthermore, switch 20, e.g. in the form of a pushbutton, is arranged on a top side of housing 10 by means of which signal generating device 14 located in the housing can be actuated in order to generate signals for actuating and deactuating the security device. Evaluation unit 4 arranged in the vehicle to be secured is connected on its output side to door locking device 24 as well as to other devices basic for the operation of the vehicle, e.g., to starter 26 and/or gas pump 28 and/or injection system 30. Of course, even other or further vehicle devices can be connected to the evaluation unit. The arrangement shown in Figure 1 is known and will therefore not be described in detail.

Figure 3 [sic; 2] shows the operating principle of the security device of the invention. In order to generate an unlocking code, signal generation device 14 arranged in housing 10 of key 8 comprises device 32 for generating a fixed code, device 34 for generating a rolling code and encoding device 36. Device 32 for generating a fixed code is a memory in the simplest instance. The fixed code can be, e.g., a 16-bit binary code associated individually with each individual vehicle. Generation device 34 comprises a circuit for generating a rolling code that can also be a 16-bit binary code. However, in distinction to the fixed code, it changes at each actuation of switch 20. In an especially simple embodiment this change can consist in that the value of the rolling code is increased by the value 1 upon each actuation of the switch.

The output signals of code generation devices 32, 34 are supplied to encoding unit 36. It generates an encoded unlocking signal by linking received fixed code F and received rolling code R. The encoding takes place in such a manner that it is not possible to recognize in a simple manner the changing rule forming the base for the rolling code generated in unit 34 from the unlocking code. This is achieved in particular by a suitable logical linking of the signals, preferably by an AND or an EXOR linking or a combination of these logical linkings with arithmetic or logical operations. The output signal of encoding device 36 is supplied to a transmission device (not shown) that emits it via antenna 38 arranged in housing 10.

The encoded unlocking signal is received on the vehicle by antenna 6 and supplied to decoding device 40, which is part of evaluation unit 4. It is designed to undo the encoding action in coordination with encoding device 36. Accordingly, decoding device 40 regenerates fixed code F and rolling code R from the received unlocking signal. Via lines 42, 44 it supplies the former to device 46 for checking the fixed code and the second to device 48 for checking the rolling code. All elements 42 to 48 are also components of evaluation unit 4. In order for security device to release the vehicle operation, fixed code F as well as rolling code R must be found to be in order. To this end checking device 46 checks whether fixed code F supplied from decoding device 40 agrees with a reference fixed code F present in evaluation device 4, e.g. in memory 45. If this is the case, it emits a permission signal for carrying out the following logical operations.

In order to check the correctness of rolling code R obtained from decoding device 40, check device 48 checks whether the received rolling code differs in a predetermined manner from the rolling code R received during the last admissible unlocking, that was filed to this end, e.g., in memory 47. In an especially simple embodiment of the security device of the invention, this check consists in examining whether the difference between the currently received rolling code R and the R_N that was the last one used before it has the value one. If the result of the check is positive, check device 48 generates a permission signal in order to bring about the further logical operations for releasing the operation of the vehicle. If both check devices 46, 48 have emitted a permission signal, evaluation unit 4 interprets the received unlocking signal as a signal generated by an authorized user and unlocks the security device. If, on the other hand, one or both of the signals emitted by check devices 46, 48 is/are not a permission signal, evaluation unit 4 interprets the received unlocking signal as an unauthorized signal and retains the vehicle locking. An unlocking of the vehicle is thus in particular not possible with a simple copy of the signal used during the previous unlocking.

There is the possibility that switch 20 is actuated when key 8 is not even in the vicinity of the vehicle. This can happen, for example, if a child is playing with key 8 in an unforeseen manner and actuates switch 20. As a consequence thereof, it can happen that the rolling code R generated by generation device 34 is no longer the code directly following code R_N present in check device 48, or in other words: generation device 34 and check device 48 are desynchronized. In order to make it nevertheless possible to start a vehicle by an authorized person in such cases, it is advantageous during the check by check device 48 to also find such rolling codes R in order that differ from the code R_N present in evaluation device 4 by not more than a given amount K regarding their formation sequence. It proved to be advantageous in practice to set this amount K at a value between 100 and 500, preferably at 250.

It is possible, in spite of allowing a certain desynchronization between the code generated in key 8 and the rolling code expected by evaluation unit 4, that the two codes deviate from

another by more that the permitted extent, that allows, e.g., a desynchronization of up to K = 250 formation steps. Such an instance can occur, e.g., as a consequence of a failure of the voltage supply of generation device 14 in key 8 or evaluation unit 4.

A preferred embodiment of the invention therefore provides the possibility of a new synchronization between the code generated in generation device 14 and the rolling code expected by evaluation unit 4. According to the invention, in the case of a desynchronization, a new synchronization is achieved in that switch 20 arranged on key 8 is actuated a set number of times within a set time period. It is provided in the exemplary embodiment that switch 20 is to be actuated five times within a period of 10 seconds for a new synchronization. At this time the check of fixed code F by check device 46 takes place in unchanged form. Rolling code R is also updated in unchanged form upon each actuation of switch 20 in accordance with the set formation rule, in the simplest case by being incremented by one.

Figure 3 shows a flow chart of the code check in evaluation unit 4. After decoding of the received unlocking signal in decoding device 40 in step 58, evaluation unit 4 first checks in step 59 whether fixed code F transmitted with the unlocking signal is in order. If this is not the case, it waits for the next received signal F, R and no unlocking takes place. If the result of the fixed code check in step 59 is positive, the check takes place in step 60 whether received rolling code component R of the unlocking signal is in the area between rolling code R_N used during the last unlocking and rolling code R_{N+K} with the ordinal number N + K. If the rolling codes can be considered as numbers corresponding to their ordinal number, this check is represented as follows: $R_N < R < R_N + K$? If the rolling code is in the area [N, ..., N + K] predefined in this manner, the evaluation unit replaces rolling code R_N from the last unlocking in step 74 with the current rolling code R and deactivates the security device. If the check in step 60 shows that rolling code R is not in the predefined range, there is a desynchronization. Evaluation unit 4 then checks in step 62 whether rolling code R is the one following internal code R_i filed in an intermediate memory as regards its ordinal number. If codes R, R_i can be represented as ordinal numbers, step 62 corresponds to the check of whether codes R and R_i differ by the value of one. If the difference does not correspond to the value of one, which is generally the case at first given the presence of a desynchronization, internal rolling code R_i, which was at first any arbitrary code filed in the intermediate memory 49, is replaced by the current rolling code R not in synchronization in step 64. A release of the vehicle operation does not take place.

Following step 64, evaluation unit 4 awaits the reception of the next unlocking signal F, R. The rolling code contained in it is again necessarily outside the admissible range checked in step 60 if a desynchronization is present, for which reason step 62 is automatically carried out. After value R_i present in the intermediate memory has been replaced by value R during the check of the previous unlocking signal, the condition checked in step 62 is now met. Therefore, in the

next step 66 the state of a meter Z is increased by 1. The obtained meter state Z is then checked in following step 68 to see whether it has reached a predetermined value P, e.g., value 5. If this is not the case, the content of intermediate memory 49 is again replaced in step 64 by the current rolling code R. Subsequently, evaluation unit 4 again awaits the input of the next unlocking signal F, R. Steps 59, 60, 62, 66, 68, 64 are repeated until the state of the meter has reached set value P checked in step 68. If this value is, e.g., five, an unlocking signal F, R must be sent to evaluation unit 4 a total of six times for a new synchronization. Finally, if the result of the check in step 68 is positive, the value of rolling code R_N present from the last unlocking action is replaced in step 72, analogously to step 74, by the value of current rolling code R and the security device is deactuated. In order for the new synchronization to be successful, the repeated sending of an unlocking signal to increase the meter in step 66 to the set value must take place within a set time period. If the set value is five, this time period can be, e.g., 10 seconds. It is realized in the exemplary embodiment by time meter 70 that monitors the rise in counting in step 66. If the meter does not receive the number of counting commands necessary for attaining the value tested in step 68 within the set time, the time meter is reset. The new synchronization must then be restarted.

After the determination of the input of a correct unlocking signal in step 74 or 72 with subsequent release of the vehicle operation, the evaluation unit goes into a waiting position and awaits the input of new unlocking code signals F, R.

Signal generation device 14 arranged in key 8 as well as evaluation unit 4 located in the vehicle can be designed by discrete components as well as advantageously in the form of a device processing digital signals such as, e.g., a microprocessor or an ASIC.

A plurality of variations of the exemplary embodiment presented can be found while retaining the concept of the invention of continuously changing the unlocking signal, allowing that the unlocking code transmitted with the unlocking signal and a reference code differ from one another in a set frame and additionally providing the possibility of a new synchronization. This applies in particular to the design of the signal generation device in the key and of the evaluation unit in the vehicle and also, e.g., for the manner of linking the fixed and the rolling code in encoding device 36.

Claims

1. A device for the contactless securing of a vehicle with a device (14) for generating an unlocking signal that contains switching means (20) for triggering the operation of the signal generation device and means (36, 38) for emitting the unlocking signal in encoded form and with a device (6, 4) for receiving and evaluating the unlocking signal, characterized in that the signal

generation device (14) comprises means (32, 34, 36) for changing the unlocking signal at each successive actuation of the switching means (20).

2. The device according to Claim 1, characterized in that the means for changing the unlocking signal comprises means (32) for generating a fixed code (F), means for generating a rolling code (R) that changes upon each actuation of the switching means (20), and means (36) for linking the fixed code (5) to the rolling code (R) in accordance with a set rule.

3. The device according to Claim 1, characterized in that the evaluation unit (4) comprises a check device (48) that checks whether a rolling code (R) is greater relative to an ordinal number updated at each actuation of the switching means (20) than the rolling code (R_N) used in the last successful deactivation of the security device.

4. The device according to Claim 3, characterized in that the check device (48) checks whether a rolling code (R) is smaller relative to an ordinal number updated at each actuation of the switching means (20) than the number that results by adding a set value (K) to the cardinal number (N) of the rolling code (R_N) used in the last successful unlocking.

5. The device according to one of the previous claims, characterized in that means are provided for making possible a new synchronization between a received code and a rolling code (R) expected by the evaluation unit (4).

6. The device according to Claim 5, characterized in that the means for the new synchronization comprises a memory (47) for storing the last rolling code (R_N), a comparison device (62) for comparing the last rolling code (R_N) with the current rolling code (R), and a time-controlled counting device (66, 68, 70) that deactivates the security device if a set number of successive rolling codes (R) goes to the comparison device (62) within a set time.

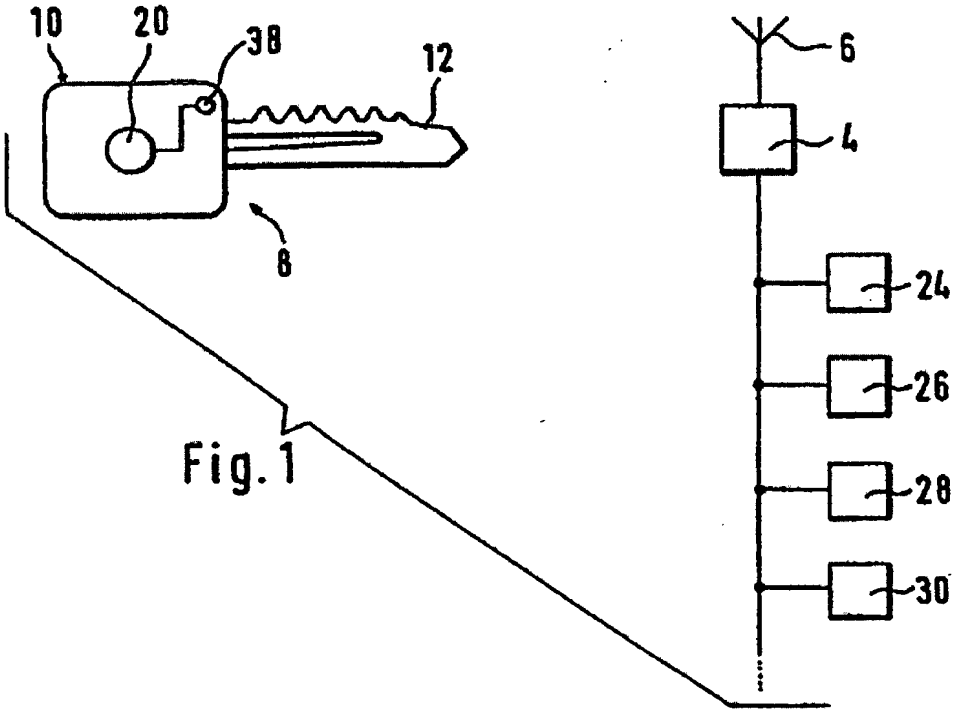


Fig. 1

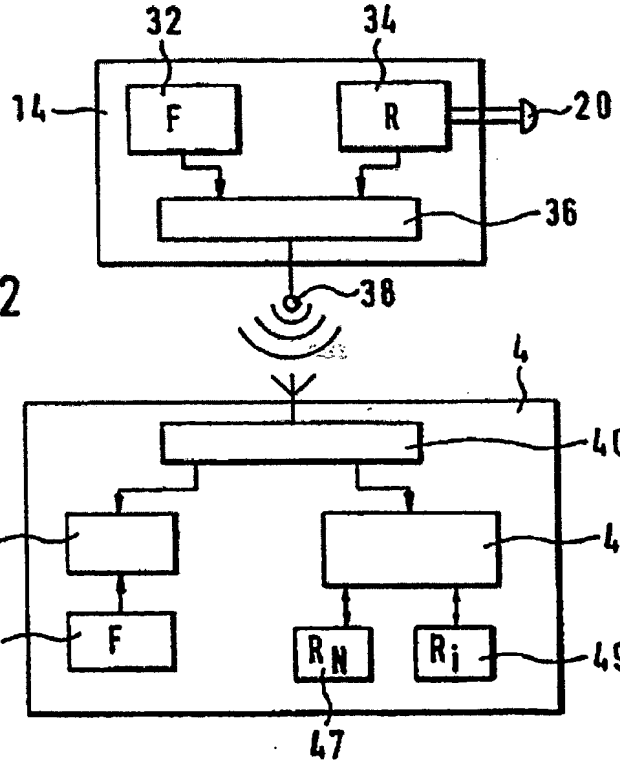


Fig. 2

Fig. 3